

## Effect of Farm Yard Manure and Planting Densities on Growth, Yield and Quality of Okra under Natural Farming

Shariq Mahmood Alam<sup>1\*</sup>, Muhammad Arshad Ullah<sup>2</sup>, Syed Ishtiaq Haider<sup>2</sup>, Nausherwan N. Nawab<sup>1</sup>, Syeda Sana Aamir<sup>1</sup> and Imdad Ali Mahmood<sup>2</sup>

<sup>1</sup>Horticultural Research Institute, National Agricultural Research Centre, Islamabad, Pakistan

<sup>2</sup>Land Resources Research Institute, National Agricultural Research Centre, Islamabad, Pakistan

\*Corresponding Author: Shariq Mahmood Alam, Horticultural Research Institute, National Agricultural Research Centre, Islamabad, Pakistan, Email: m.smahmoodisb@gmail.com

### ABSTRACT

A field study was conducted to investigate the effect of farm yard manure and planting densities ( $P \times P$  10, 15, 20 and 25 cm and  $R \times R$  60 cm) under natural farming condition at National Agricultural Research Centre, Islamabad during 2016. The land was incorporated with well rotten farm yard manure (FYM) @ 25 t ha<sup>-1</sup> in respective plots (4 x 8 meter) one week before bed preparation and mixed thoroughly in the soil. Seeds of okra (*Abelmoschus esculentus* L., var. Pusa Green) were sown according to the plan following split plot design with four replications. The crop was allowed to stand till maturity and data on growth traits like plant height, number of pods plant<sup>-1</sup> and fresh pod yield (tender young pods) were recorded. The quality characters like crude fiber and moisture percentage were estimated. The mean data were analyzed statistically. Though all the FYM application treatments showed positive effect through growth and yield characters, however, among plant densities, 10 and 15 cm  $P \times P$  and FYM incorporation @ 25 t ha<sup>-1</sup> produced comparable fresh pod yield (11.22 and 10.97 t ha<sup>-1</sup>, respectively) which was 25 and 24 % higher than that of without FYM application. Dense populated crop i.e., 10 and 15 cm  $P \times P$  performed better than rest of planting densities through improved fresh pod yield with comparatively improved quality. Dense populated treatment ( $P \times P$  10 cm) and FYM application @ 25 t ha<sup>-1</sup> produced better quality fruits with less crude fiber content (9.89 %) and higher moisture content (79.14 %) as compared to without FYM application (10.93 and 77.49 %) respectively that indicates more accumulation of dry matter content in fruits.

**Keywords:** Okra; Organic Farming; Planting Densities; Farm Yard Manure; Growth; Fresh Pod Yield; Quality

### INTRODUCTION

Among rapidly consumed vegetables, okra is one popular green crop in Pakistan grown during spring summer season. As the plant life cycle falls in short duration crops, proper plant nutrition for high yielding varieties influence greatly on the production and quality traits of okra. To regulate high quality fruiting and sufficient picking adequate minerals are essential for potential fruit yield required by okra plant. Trend of intense cultivation of agricultural crops resulted in the degradation of fertile land. Recently awareness of organic farming and sustainable agriculture is taking charge over intensive farming systems around the globe. Organic manure is one of the best choices to full fill the needs of plant essential mineral nutrition for enhanced quality and crop yielding, along with properties of improving soil structure, texture and moisture holding capacity

(Maheswarappa et al., 1999). Although the amount of micro minerals is reasonable in organic manures as compared to inorganic fertilizers, existence of growth promoting components like hormones and enzymes besides mineral nutrition of plants makes them essential for improvement of soil fertility and productivity (Bhuma, 2001). It is well known fact that farm yard manure (FYM) definitely improves the soil to sustain the nutrient status and water holding capacity.

The significance of organic manuring in sustainable agriculture is acknowledged well. Gaur et al., 1972 and Subbarao et al., 2001 reported that the application of different organic manures showed a significant increase in plant height and number of fruits plant<sup>-1</sup> of chilli (Dileep, 2005). Use of manure from animal and plant origin is most common practice for sustainable and organic farming around the

## Effect of Farm Yard Manure and Planting Densities on Growth, Yield and Quality of Okra under Natural Farming

globe. Besides, proper plant population in a field is an important aspect affecting the yield of okra. Working with okra variety Lady Finger, planted at 33,333 plants ha<sup>-1</sup> in north central Nigeria, Ijoyah and Dzer (2012) reported a fruit yield range of 5.7-6.0 Mt ha<sup>-1</sup>. Higher plant population may result in decreased plant growth and yield due to competition for nutrients among themselves. However, increased population may compensate for reduction in growth and yield. Amjad et al. (2001) working with cv. Sabz Pari, under different climatic conditions in Pakistan produced the most mature pods per plant, highest weight of mature pods per plant, and highest seed yield per plant at a population of 111,000 plants ha<sup>-1</sup>, produced okra yield of 14-31 kg plant<sup>-1</sup>. Generally, increased planting density results in increased yield per unit area up to a certain limits. Optimal population density for high yielding okra cultivars is much important (Ibeawuchiet al, 2005; Moniruzzaman et al, 2007).

There is increasing demand for okra because of its importance for delicious cooking in farming systems in many regions. It is a good source of vitamins A, B, and C and iron, calcium, magnesium, phosphorus, and zinc (Asian Vegetable Research Development Council, 1991). The edible part of okra represents 90% of the total weight of fruit with an energy value of 31 kcal per 100 g (De Lannoy, 2001). Keeping

in mind these facts, a field experiment was planned to assess the effects of farm yard manure and plant density on yield and quality of okra to determine the optimum population for maximum fruit yield production with better quality attributes of okra var. Pusa green under natural farming environment.

### MATERIALS AND METHOD

A Field study was carried out to investigate the effect of farm yard manure (FYM) and planting densities (P x P = 10, 15, 20 and 25 cm and R x R = 60 cm) under natural farming condition during dry season 2016 at National Agricultural Research Centre, Islamabad. The land was incorporated with well rotten farm yard manure (FYM) @ 25 t ha<sup>-1</sup> in respective plots (4 x 8 meter) one week before bed preparation and mixed thoroughly in the soil. The experiment was laid out according to split plot design with four replications.

Four seeds of okra (*Abelmoschus esculentus* L., var. Pusa Green) were directly sown per hole at a depth of 2 cm. After germination, seedlings were thinned to one plant per stand three weeks after planting. Soil samples from (0-30 cm) were collected from 12 different spots in the study area and were composited, air-dried and sieved through a 5 mm sieve and their physical and chemical characteristics were determined before application of treatment (Table 1).

**Table 1.** Physico-chemical characteristics of the soil (0-30 cm) at the experimental sites in 2016 at NARC, Islamabad

Parameters	Unit	Values	
		Before Sowing	After Harvest
pH	–	8.64	8.51
ECe	dS m <sup>-1</sup>	0.32	0.29
CaCO <sub>3</sub>	%	4.87	4.84
OM	%	0.35	0.38
NO <sub>3</sub> -N	%	2.72	3.19
Extractable P(AB-DTPA)	mg kg <sup>-1</sup>	2.16	2.74
Extractable K (AB-DTPA)Zn	mg kg <sup>-1</sup>	84.73	85.57
(ABDTPA)	mg kg <sup>-1</sup>	1.78	2.01
Sand	%	31.70	31.70
Silt	%	28.29	28.29
Clay	%	40.11	40.11
<b>Textural Class</b>	–	<b>Sandy clay loam</b>	<b>Sandy clay loam</b>

The samples were analyzed for soil textural class by hydrometer method (Bouyoucos, 1962). Calcium carbonate was estimated by acid neutralization method and soil organic matter by oxidation with potassium dichromate in sulfuric acid medium under standardized conditions by Walkley and Black procedure (Nelson and

Sommers, 1982). Soil pH was determined in water (soil water ratio 1:1). Electrical conductivity (ECe) of the soil suspension was measured using conductivity meter. The P, K and Zn were determined by using AB-DTPA method (Ryan et al., 2001). The crop was allowed to stand till maturity and data on growth

## Effect of Farm Yard Manure and Planting Densities on Growth, Yield and Quality of Okra under Natural Farming

characters like plant height, number of fruits plant<sup>-1</sup> and yield (tender young pods) were recorded. The quality characters like crude fiber and moisture percentage were estimated. The data thus collected were subjected to statistical analysis and treatment differences were compared by using LSD (Gomez and Gomez, 1984).

### RESULTS AND DISCUSSION

All the treatments of FYM application @ 25 t ha<sup>-1</sup> along with dense plantation performed significantly in terms of plant height, pods plant<sup>-1</sup>, pod yield (t ha<sup>-1</sup>), crude fiber contents (%) and

moisture contents (%) over non FYM treatments and less dense okra population. Data in Tables 2, 3 and 4 registered statistically significant increase in okra plant growth, yield and quality among all treatments receiving FYM over control treatments (without FYM) and dense population. Results listed in Table 2 advocate that treatment receiving FYM @ 25 t ha<sup>-1</sup> showed maximum plant height 54.34 (cm) and peak number of pods plant<sup>-1</sup> 23.77. Similar findings were reported by Premsekhar and Rajashree (2009) in response to the FYM application in okra farming.

**Table 2.** Plant height and number of pods of okra as affected by farm yard manure and planting densities during 2016 (Average of three Repeats)

Planting Densities	Plant Height (cm)		Mean	Number of Pods Plant <sup>-1</sup>		Mean
	+ FYM	- FYM		+ FYM	- FYM	
10 cm	55.10 a	34.25 c	44.68 <sup>NS</sup>	21.63 b	14.43 d	18.03 B
15 cm	54.45 ab	34.19 c	44.32	22.65 ab	15.68 cd	19.17AB
20 cm	53.93 ab	33.98 c	43.96	24.87 a	17.67 c	21.27 A
25 cm	53.88 ab	33.87 c	43.88	25.92 a	17.84 c	21.88 A
Mean	54.34 A	34.07 B		23.77 A	16.41 B	

Means bearing same letter(s) in each column are statistically similar at  $p \leq 0.05$ ; <sup>NS</sup> Means in each column are non-significant

**Table 3.** Pod length, fresh pod weight and fresh pod yield of okra as affected by farm yard manure and planting densities during 2016. (Average of three Repeats)

Planting Densities	Pod Length (cm)		Mean	Fresh Weight Pod <sup>-1</sup> (g)		Mean	Fresh Pod Yield (t ha <sup>-1</sup> )		Mean
	+ FYM	- FYM		+ FYM	- FYM		+ FYM	- FYM	
10 cm	9.13 a	5.17 ab	7.15 AB	43.25 b	26.59cd	34.92 B	11.22 ab	10.97 bc	11.10 A
15 cm	9.14 a	5.12 b	7.13 AB	43.99 b	26.87cd	35.43 B	10.97 bc	8.81 c	9.89 B
20 cm	9.84 ab	5.67 bc	7.83 A	45.44 ab	28.78 c	37.11 A	9.46 c	7.98 c	8.72 BC
25 cm	9.98 ab	6.28 c	8.06 A	45.92 a	29.46 c	37.69 A	8.25 c	7.52 cd	7.89 C
Mean	9.52 A	5.56 B		44.65 A	27.93 B		9.98 A	8.82 B	

Means bearing same letter(s) in each column are statistically similar at  $p \leq 0.05$ ; <sup>NS</sup> Means in each column are non-significant

Results mentioned in Table 3 indicate that FYM applied treatments produced significantly higher fresh pod yield (11.22 t ha<sup>-1</sup> and 10.97 t ha<sup>-1</sup>) of okra planted with 10 and 15 cm planting distances, respectively against 10.97 t ha<sup>-1</sup> and 8.81 t ha<sup>-1</sup> under same planting densities without FYM application. Comparatively less fresh pod yield under no FYM application might be due to lack of nutrients resulting in reduced growth and yield. The positive effect of FYM on plant growth and yield could be due to the contribution made by manure to fertility status of the soil as the soils were low in organic matter (Table 1).

Manure when decomposed increases both macro and micro nutrients as well as enhances the physico-chemical properties of the soil. This

could have led to its high vegetative growth. The significant difference observed in the treatments supplied with FYM as compared to control treatment (without FYM) could be due to the presence of nutrients in the soil which satisfied plants requirements for their health growth. Ajari et al., (2003) reported that in okra production organic manure could increase plant height of crops when compared with other sources of manures or having no manures. Similar findings had also been reported by Premsekhar and Rajashree (2009).

Furthermore, higher and statically significant values of fresh pod length (9.98 cm) and fresh pod weight (45.92 g) of okra under normal plant population (20 × 20 cm) were recorded. On an average, FYM @ 25 t ha<sup>-1</sup> application also

## Effect of Farm Yard Manure and Planting Densities on Growth, Yield and Quality of Okra under Natural Farming

showed elevated pod length (9.52 cm) and weight of fresh pod (44.65 g pod<sup>-1</sup>), respectively as compared to non FYM treated plots. An opposite trend was observed regarding quality of okra pod fruits in terms of minimum crude fiber (8.87 %) and higher moisture (78.90 %) contents harvested from FYM treated (25 t ha<sup>-1</sup>) under dense populated okra plants (Table 4), as

okra pods are found to be the best for cooking and consumption with lesser crude fiber contents. Previous findings of Dileep (2005), Gopalakrishnan (2007) and Tiamiyu et al., (2003) are in line with our results who reported that FYM increased yield and quality of vegetables providing healthy environment and good soil structure and texture.

**Table 4.** Crude fiber and moisture content of okra as affected by farm yard manure and planting densities during 2016. (Average of three Repeats)

Planting Densities	Crude Fiber Content (%)		Mean	Moisture Content (%)		Mean
	+ FYM	- FYM		+ FYM	- FYM	
10 cm	9.89 b	10.93 a	10.01 <sup>NS</sup>	79.14 <sup>NS</sup>	77.49	78.32 <sup>NS</sup>
15 cm	9.14 b	10.91 a	9.68	78.87	77.41	78.14
20 cm	8.59 bc	11.14 a	9.97	78.79	77.43	78.11
25 cm	7.84 c	11.18 a	9.56	78.78	77.24	78.01
Mean	8.87 B	10.74 A		78.90 <sup>NS</sup>	77.39	

Means bearing same letter(s) in each column are statistically similar at  $p \leq 0.05$ ,<sup>NS</sup> Means in each column are non-significant

Both interventions FYM and planting densities yielded significant mean fresh pod yield increase 13% and 12% with application of FYM @ 25 t ha<sup>-1</sup> and planting density P x P 10 cm as compared to no FYM application and planting densities P x P 15 cm, respectively. The mean fresh pod yield was improved with P x P 10 cm significantly 41% over planting densities P x P 25 cm.

The fundamental reason for the improved fresh pod yield might be owing to higher plant population that might have recompensed the fresh pod yield. Amjad et al. (2001) working with cv. Sabz Pari, under different climatic conditions in Pakistan produced the most mature pods per plant, highest weight of mature pods per plant, and highest seed yield per plant at a population of 111,000 plants ha<sup>-1</sup>, produced okra yield of 14-31 kg plant<sup>-1</sup>.

Generally, increased planting density results in increased yield per unit area up to a certain limits. Similar findings have also been documented by Ibeawuchi et al, (2005) and Moniruzzaman et al, (2007) who reported that optimal population density for high yielding okra cultivars is much important.

Further FYM definitely provided favorable environment for health growth and ultimately higher yield. Comparatively the superior quality in okra may be due to FYM application resulting in improved nutritional availability of soil in terms of NO<sub>3</sub>, H<sub>2</sub>PO<sub>4</sub> and trace elements (Zn, Cu, Fe, Mn and Mg) availability, which has

significantly improved chlorophyll content in leaves, several biochemical components and coenzymes were being more active in response to trace elements that ultimately enhanced the photosynthetic and metabolic activities that promoted higher cell division giving maximum yield, current findings are in settlement to the reported material of Anburani and Manicannan (2002); Nehra et al. (2001) and Sanwal et al. (2007).

## CONCLUSION

Current experimentation has revealed that farm yard manure (FYM) application @ 25 t ha<sup>-1</sup> actively enhanced vegetative growth, increased yield and improved pod quality traits of okra. In addition, dense plantation (P x P 10 cm) improved fresh pod yield per unit area of okra vegetable. For attaining a higher yield and maximum quality of okra FYM @ 25 t ha<sup>-1</sup> application and plantation at higher density (P x P 10 cm) could be a very effective protocol for organic and sustainable farming under natural farming.

## REFERENCES

- [1] Ajari, O., Tsado, L.E.K., Oladiran, J.A. and Salako, E.A. 2003. Plant height and fruit yield of okra as affected by field application of fertilizer and organic matter in Bida, Nigeria. The Nigerian Agric. J., 34: 74 – 80.
- [2] Amjad, M., M.A. Anjum and A. Ali. 2001. Effects of phosphorus and planting density on seed production in Okra (*Abelmoschus esculentus* L. Moench). Intl. J. Agr. Biol. 3(4):380-383.

## Effect of Farm Yard Manure and Planting Densities on Growth, Yield and Quality of Okra under Natural Farming

- [3] Anburani, A. and K. Manivannan. 2002. Effect of integrated nutrient management on growth in brinjal. *South Indian Hort.*, 50(4-6): 377-386.
- [4] Asian Vegetable Research Development Council. 1991. Vegetable research and development in the 1990's- a strategic plan. AVRDC Publication, Shanhua, Taiwan.
- [5] Bhuma, M. 2001. Studies on the impact of humic acid on sustenance of soil fertility and productivity of green gram. MSc (Ag) Thesis, TNAU, Coimbatore.
- [6] Bouyoucos, G.J. 1962. Hydrometer method improved for making particle size analysis of soil. *Agronomy Journal*, 54: 464-65.
- [7] De Lannoy, G. 2001. Vegetables: Crop production in Tropical Africa, p. 403-511. Directorate General for Intl. Cooperation, Brussels, Belgium.
- [8] Dileep, S.N. 2005. Studies on effect of organic manures on the productivity and quality of chilli CV K1, MSC (Hort). Thesis. TNAU, Coimbatore.
- [9] Gaur, A.C.R., V.S. Rao and K.V. Sadasivam. 1972. Soil structure as influenced by organic matter and inorganic fertilizers Labden. *J. Sci Technol India*, 10-B: 55.
- [10] Gomez, K.A. and A.A. Gomez. 1984. Statistical procedure for agricultural research, 2<sup>nd</sup> Ed., John Wiley and Sons., New York, USA.
- [11] Gopalakrishnan, T.R. 2007. Vegetable Crops. *Hort. Sci. Series.*, 4. pp: 32-33.
- [12] Ibeawuchi, I.L., J.C. Obiefuna, and M.C. Ofoh. 2005. Effects of row spacing on yield and yield components of okra and mixture groundnut. *J. Agron.* 4:304-307.
- [13] Ijoyah, M.O. and D.M. Dzer. 2012. Yield Performance of okra and maize as affected by time of planting maize in Makurdi, Nigeria. *Agronomy* 12:1-7.
- [14] Maheswarappa, H.P., H.V. Nanjappa, M.R. Hegde and S.R. Balu. 1999. Influence of planting material, plant population and organic manures on yield of East Indian Galangal and on soil physiochemical and biological properties.
- [15] Moniruzzaman, M., M.Z. Uddinand A.K. Choudhury. 2007. Response of okra seed crop to sowing time and plant spacing in south eastern hilly region of Bangladesh. *Bangladesh. J. Agr. Res.* 32(3):393-402.
- [16] Nehra, A.S., I.S. Hooda and K.P. Singh. 2001. Effect of integrated nutrient management on growth and yield of wheat (*Triticum aestivum* L.) *Indian J. Agron.*, 45: 112-17.
- [17] Nielson, S.W. and I.E. Sommers. 1982. Total carbon, organic carbon and organic matter. p. 539-580. *In: Methods of Soil Analysis. Part-II. Chemical and Microbial Properties.* A.L Page, (ed.) Amer. Soc. Agron. Madison, Wisconsin, USA.
- [18] Premsekhar, M. and V. Rajashree. 2009. Influence of Organic Manures on Growth, Yield and Quality of Okra. *Am.-Eurasian J. Sustain. Agric.*, 3(1): 6-8.
- [19] Ryan, J., G. Estefan and A. Rashid. 2001. *Soil and Plant Analysis Laboratory Manual*, p: 172. International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria
- [20] Sanwal, S.K., K. Lakminarayana, R.K. Yadav, N. Rai, D.S. Yadav and B. Mousumi. 2007. Effect of organic manures on soil fertility, growth, physiology, yield and quality of turmeric. *Indian J. Hort.*, 64(4): 444-449.
- [21] Subbarao, T.S.S. and C. Ravi Shankar. 2001. Effect of organic manures on growth and yield of brinjal. *South Ind. Hort.*, 49(Special): 288-291.
- [22] Tihamiyu, R.A., H.G. Ahmed and A.S. Muhammad. 2012. Effect of sources of organic manure on growth and yields of okra (*Abelmoschus esculentus* L.) in Sokoto, Nigeria. *Nigerian J. Basic and Appl. Sci.*, 20(3): 213-216.

**Citation:** Shariq Mahmood Alam, Muhammad Arshad Ullah, Syed Ishtiaq Haider et al, "Effect of Farm Yard Manure and Planting Densities on Growth, Yield and Quality of Okra under Natural Farming", *International Journal of Research in Agriculture and Forestry*, 6(4), 2019, pp 21-25.

**Copyright:** ©2019 Shariq Mahmood Alam et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.